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## Water Desalination Research and Development Program

Kevin Price

The Water Desalination Research and Development Program (DesalR&D) Program, Public Law 104-298, is authorized for FY 1997 - 2002.

The United States has limited water resources, and the demand for water is ever increasing as the population increases. Desalination, the process of producing usable water from saline water, is one of few very limited methods to increase these resources; however, it is not affordable for most communities. Until recently, desalting technology was viewed only in terms of seawater or brackish water treatment for municipal water supplies. Today, desalting technology is being used in an ever-increasing arena of applications, including treatment of industrial effluent, municipal wastewater reuse, groundwater recharge, production of ultrapure water, military water production, irrigation drainage, and hazardous waste treatment. Even with these expanded applications of desalting technologies, the cost of desalting is not affordable for most U.S. communities.

To address these and other technology, application, and cost issues, the DesalR&D Program was authorized by the Water Desalination Act of 1966 (Act), Public Law 104-298. The Act is based on the fundamental need in the U.S. and world-wide for additional sources of potable water. The principal focus of the Act is to develop more economical methods to produce purified water from saline water or otherwise impaired water sources. The Act contains two principal thrusts: (1) perform research of desalination technologies and related issues to push the state of the art forward so costs can be reduced (research and studies) and (2) conduct development and demonstration activities to test technological advancements, confirm economics, and gain public acceptance (development projects).

The primary objective of the DesalR&D Program is to develop more cost-effective, technologically efficient, and implementable means to desalinate water. This objective is accomplished through a combination of in-house research projects and largely through the award of competitively-bid, merit-reviewed, cost-shared (minimum 50 percent) research financial assistance agreements. In-house projects can be accomplished either with Reclamation partners (Yuma Area Office, Phoenix Area Office, etc.), other Federal government agencies, or by researchers in the Technical Service Center in Denver. Whereas, financial assistance agreements are accomplished strictly by partners outside Reclamation, the Program objective is accomplished through the administration of several tasks, each of which has its own principal research thrust, including:

- Membrane process research and development studies
- Thermal process research and development studies

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- Non-traditional and alternative desalination research and studies
- Water recycling and reuse
- Ancillary and economic improvements
- Concentrate issues
- Testing of pilot-scale systems
- Design, construction, and testing of plants and modules
- Partnerships
- Technology transfer

All tasks received funding in FY 1999 except testing of plants and modules. Work within this task will not begin until funding levels support demonstration-phase projects and research findings from other tasks can be successfully evaluated and recommendations made concerning demonstration and development.

The following list of accomplishments includes 22 in-house research projects, 14 financial assistance agreements, 2 Interagency Agreements, and 7 Sole Source Agreements awarded during FY 1999. These accomplishments include support of financial assistance agreements that are extensions from the DesalR&D Program's predecessor, the Water Treatment Technology Program (WTPP).

Task A, Membrane Process Research and Development Studies (Task Leader, Frank Leitz):

WTPP Agreements and Projects from Previous Fiscal Years - American Water Works Association Research Foundation (AWWARF) Cooperative Agreement, Microbial Removal and Integrity Monitoring of High-Pressure Membranes Used in Water Treatment. The project will end September 30, 2000, and a final AWWARF research report will be published.

The following financial assistance agreements are completed, final reports have been submitted and will be published: University of Missouri, Reduction of Iron Fouling in Groundwater Aerators; University of California at Berkeley, Algal Bacteria Selenium Removal System for Treatment of Irrigation Drainage Water; Demonstration Facility Studies; CLF Technologies, Bioresin Development for Removal of Toxic Metals from Water; City College of New York (CCNY) and New York City (NYC) Department of Environmental Protection, Comparative Evaluation of the Effects of Various Disinfectants on Attached Bacterial Growth in Drinking Water; CLF Technologies, Water Treatment for Metals with Microalgal Bioadsorbents; and CCNY and NYC Department of Environmental Protection, Biological Stability of Drinking Water.

Financial Assistance Agreements for FY 1999 - James Green and Metropolitan Water District of Southern California, Evaluation of Precipitative Fouling for Colorado River Water Desalination Using Reverse Osmosis. Mark Clark and University of Illinois, Visualization of Colloidal Phenomenon Near Membrane Surfaces.

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Menachem Elimelech and Yale University, Optimal Operational Conditions for Prevention of Membrane Colloidal and Organic Fouling. Amy Childress and University of Nevada-Reno, Prediction of Membrane Fouling.

In-House Projects for FY 1999 - Development of Integrity Testing Methods; Electrokinetic Analysis; Drying of Thin Film Composite Membranes; Yuma Desalting Plant Membranes Biofilm Formation and Removal; Chlorine Resistant Membrane Study; Resistance Model for Evaluating Interactions Between Natural Organic Matter (NOM) & Membranes at Different Scales of Operation; Permeate Flux Decline Due to NOM; and Membrane Transport Cell.

Interagency Agreements for FY 1999 - National Institute of Standards and Technology (NIST), Membrane Transport Cell.

Task B, Thermal Process Research and Development Studies (Task Leader, Harry Remmers):

Financial Assistance Agreements for FY 1999 - Richard McCormack and Thermal Energy Storage, Inc., Investigation of High Freezing Temperature, Zero Ozone, and Zero Global Warming Potential Clathrate Formers for Desalination.

Task C, Non-Traditional and Alternative Desalination Research and Studies (Task Leader, Mark Lichtwardt):

Financial Assistance Agreements for FY 1999 - James Beckman and Arizona State University, Carrier-Gas Enhanced Atmospheric-Pressure Desalination. K.K. Sikar and New Jersey Institute of Technology, Novel Membrane and Device for Direct Contact Membrane Distillation-Based Desalination Process.

In-House Projects for FY 1999 - Navajo Photovoltaic/Electrodialysis Reversal Desalting and Cooperative Work with Ben Gurion University.

Task D, Water Recycling and Reuse (Task Leader, Bob Jurenka):

WTTP Agreements and Projects from Previous Fiscal Years - Desalination Systems, Inc., New Design Feed Channel Spacer in Spiral Wound Elements for Pretreatment Cost Reduction. A final report has been submitted and will be published within the next reporting period. University of Texas at El Paso (UTEP), Salinity and Total Organic Carbon Removal Using Nanofiltration. A final report has been submitted and will be published within the next reporting period.

Financial Assistance Agreements for FY 1999 - Eric Rosenblum and the City of San Jose, Comparison of Treatment Methods for Partial Desalting of Tertiary. C.P. Huang and University of Delaware, Treatment of Wastewater for Water Reuse by a Catalytic Sonochemical Process: Phase II, Pilot-Plant Study.

In-House Projects for FY 1999 - Drinking Water Compliance.

Task E, Ancillary and Economic Improvements (Task Leader, Michelle Chapman Wilbert):

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Financial Assistance Agreements for FY 1999 - Byard Wood and University of Nevada-Reno, Improving Thermodynamic & Economic Efficiencies of Desalination Plants.

In-House Projects for FY 1999 - Water Quality Improvement Center: Kinetics of Disinfection Byproducts Formation; Denitrification Studies; Gas Supersaturation Studies; Selenium & Heavy Metal Concentrate; Normalized Desalting Costs; Water Treatment Estimation Routine (WaTER); Sludge Volume Reduction Study; and In-Line Settling Tube.

Interagency Agreements for FY 1999 - National Institute of Standards and Technology, Consulting and Lab Services for DesalR&D Project and Yuma Area Office Project.  
Task F, Concentrate Issues (Task Leader, Scott Irvine):

Financial Assistance Agreements for FY 1999 - Mike Mickley and Mickley & Associates, Membrane Concentrate Disposal: Manual of Practices & Regulations. Andrew Swift and UTEP, Zero Discharge Waste Brine Management for Desalination Plants.

Sole Source Agreement for FY 1999 - Arizona Municipal Water Users Association.

Task G, Testing of Pilot-Scale Systems (Task Leader, Bill Boegli):

Financial Assistance Agreements for FY 1998 - FY 1999 - Mr. Paul Gagliardo and the City of San Diego, California, Membrane Bioreactors for Water Purification-Phase II. Dr. Ali Dabiri and Science Applications International Corp., VARI-RO Desalting Pilot Plant Advancement Project.

A Task G Broad Agency Announcement (BAA) was advertised with awards dependent on increased FY 2000 appropriations.

In-House Projects for FY 1999 - Central Arizona Project Tucson Water Treatment Study.

Task H, Partnerships (Task Leader, Kevin Price):

Sole Source Agreement for FY 1999 - University of Colorado, Center for Membrane Applied Science & Technology (MAST).

A Task H BAA was advertised with two awards expected in the next reporting period.

Task I, Design, Construction, and Testing of Plants and Modules (Task Leader, Glenn Howard):

No activity in this task will occur until funding levels support demonstration-scale activities.

Task J, Technology Transfer (Task Leader, Kevin Price):

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In-House Projects for FY 1999 - Water Treatment Primer for Communities in Need; Interagency Consortium for Desalination and Membrane Separation Research; Homepages and Publications; and Conferences.

Sole Source Agreements for FY 1999 - AWWA, DESALNET; University of Houston, ADA Desalting Cost Model; International Desalination Association, IDA World Congress Proceedings in CD ROM format; Southern Illinois University, The Role of Desalination in Averting a Global Water Crisis; and Nabil El-Ramly, University of Hawaii, U.S. Desalting Plant Inventory Demonstration.

The DesalR&D Program partners with the academic, private, governmental, and nonprofit sectors. Each assistance agreement has at least one partner, but many have multiple partners across the sectors. The in-house projects have Reclamation partners as well as partnerships with other government agencies.

Deliverables for all financial assistance agreements include a final presentation in Denver, a final report of project findings, and many times a publication in a peer reviewed journal. Deliverables for in-house research projects include a minimum of one, but generally two, of the following: (1) publication in a journal, (2) presentation at a conference, and (3) preparation of an in-house report. These publications are all available from the website: [www.usbr.gov/water/desal.html](http://www.usbr.gov/water/desal.html).